**Small Business Innovation Research/Small Business Tech Transfer**

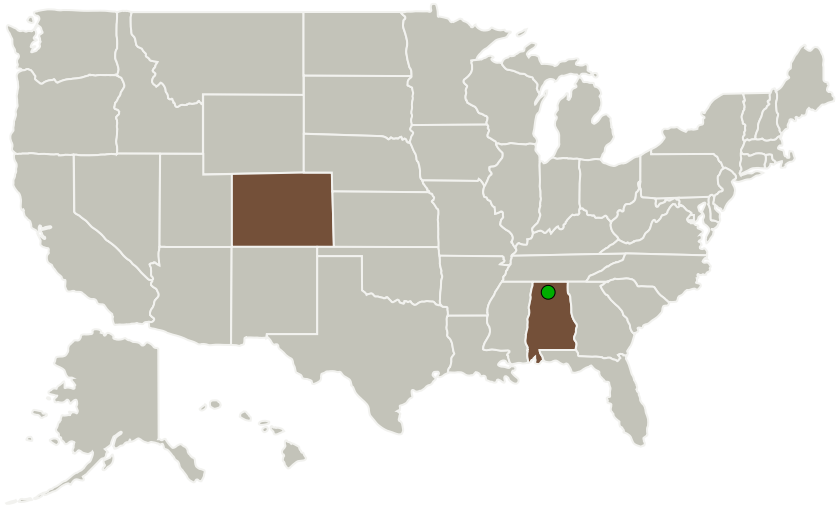
# Ultra-Lightweight Compact Heat Exchangers for Aerospace Applications, Phase I

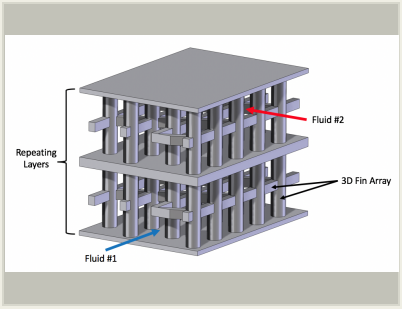
Completed Technology Project (2017 - 2017)

## Project Introduction

Spacecraft environmental and thermal control systems make use of a variety of heat exchangers and condensers to provide clean water and maintain component temperatures at acceptable levels. In many cases these heat exchangers and condensers are fabricated using passivated stainless steel to retard corrosion and fouling processes, representing a significant weight penalty even for heat exchangers with minimal solid material. Leveraging extensive experience in the design and fabrication of ultra-compact heat exchangers, evaporators, and condensers using photochemically etched thin metal laminates, microVection has developed a concept for fabricating ultra-lightweight compact microfinned heat exchangers using 3-D printing technology. The concept involves 3-D printing a frame using relatively low-cost resins, followed by fully-dense plating of the frame to produce the desired heat exchanger feature dimensions. Heat exchanger fabrication is completed through heating in a furnace to remove the frame. The result is a heat exchanger that possesses all of the benefits of a laminated microfinned heat exchanger without the design constraints of continuous load paths through the structure. The proposed effort supports the NASA goal of reducing the mass and increasing the efficiency of heat acquisition components (per the 2015 NASA Technology Roadmap, TA 14.2.1 Heat Acquisition). Specific goals of the program are to design a heat exchanger with a performance metric below 0.4 kg/kW-K, eliminate the need for bonded/brazed joints, and demonstrate the ability to fabricate the concept.

## Primary U.S. Work Locations and Key Partners






Ultra-Lightweight Compact Heat Exchangers for Aerospace Applications, Phase I Briefing Chart Image

## Table of Contents

# Ultra-Lightweight Compact Heat Exchangers for Aerospace Applications, Phase I

Completed Technology Project (2017 - 2017)

| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| microVection, Inc. | Lead Organization | Industry | Broomfield, Colorado |
| Marshall Space Flight Center(MSFC) | Supporting Organization | NASA Center | Huntsville, Alabama |

| Primary U.S. Work Locations | |
|---|---|
| Alabama | Colorado |

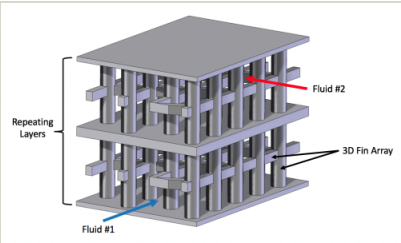
## Project Transitions

**June 2017:** Project Start

**December 2017:** Closed out

**Closeout Summary:** Two of the here vendors were able to produce 1 sq. ft. me tallic nanolattice (HRL) and carbon nanotube composite honeycomb (Orbital) cor e panels (flat and curved) which were furnished to NASA for testing. These vend ors also furnished sandwich panels from these cores (not required in the contac t). While not all of the KPPs were met, significant advancement of the technolog y was made. Orbital and HRL were able to produce core materials with mechanic al properties that exceed those of 3 lb/ft3 aluminum honeycomb (KPPs based up on 6 lb/ft3. TRL elevated to 4.

## Images




**Briefing Chart Image**
Ultra-Lightweight Compact Heat Exchangers for Aerospace Applications, Phase I Briefing Chart Image
*(https://techport.nasa.gov/image/136809)*

## Organizational Responsibility

**Responsible Mission Directorate:**
Space Technology Mission Directorate (STMD)

**Lead Organization:**
microVection, Inc.

**Responsible Program:**
Small Business Innovation Research/Small Business Tech Transfer

## Project Management

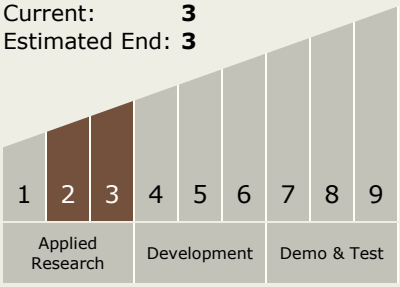
**Program Director:**
Jason L Kessler

**Program Manager:**
Carlos Torrez

**Principal Investigator:**
Geoffrey Campbell

## Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



# Ultra-Lightweight Compact Heat Exchangers for Aerospace Applications, Phase I

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## Technology Areas

**Primary:**

- TX14 Thermal Management Systems
  - TX14.2 Thermal Control Components and Systems
    - TX14.2.2 Heat Transport

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System